Basic Anatomy

Anatomy is the science of the structure and function of the body.

Clinical anatomy is the study of the macroscopic structure and function of the body as it relates to the practice of medicine and other health sciences.

Basic anatomy is the study of the minimal amount of anatomy consistent with the understanding of the overall structure and function of the body.

Descriptive Anatomic Terms

It is important for medical personnel to have a sound knowledge and understanding of the basic anatomic terms. With the aid of a medical dictionary, you will find that understanding anatomic terminology greatly assists you in the learning process.

The accurate use of anatomic terms by medical personnel enables them to communicate with their colleagues both nationally and internationally. Without anatomic terms, one cannot accurately discuss or record the abnormal functions of joints, the actions of muscles, the alteration of position of organs, or the exact location of swellings or tumors.

Terms Related to Position

All descriptions of the human body are based on the assumption that the person is standing erect, with the upper limbs by the sides and the face and palms of the hands directed forward (Fig. 1.1). This is the so-called **anatomic position.** The various parts of the body are then described in relation to certain imaginary planes.

Median Sagittal Plane

This is a vertical plane passing through the center of the body, dividing it into equal right and left halves (see Fig. 1.1). Planes situated to one or the other side of the median plane and parallel to it are termed **paramedian.** A structure situated nearer to the median plane of the body than another is said to be **medial** to the other. Similarly, a structure that lies farther away from the median plane than another is said to be **lateral** to the other.

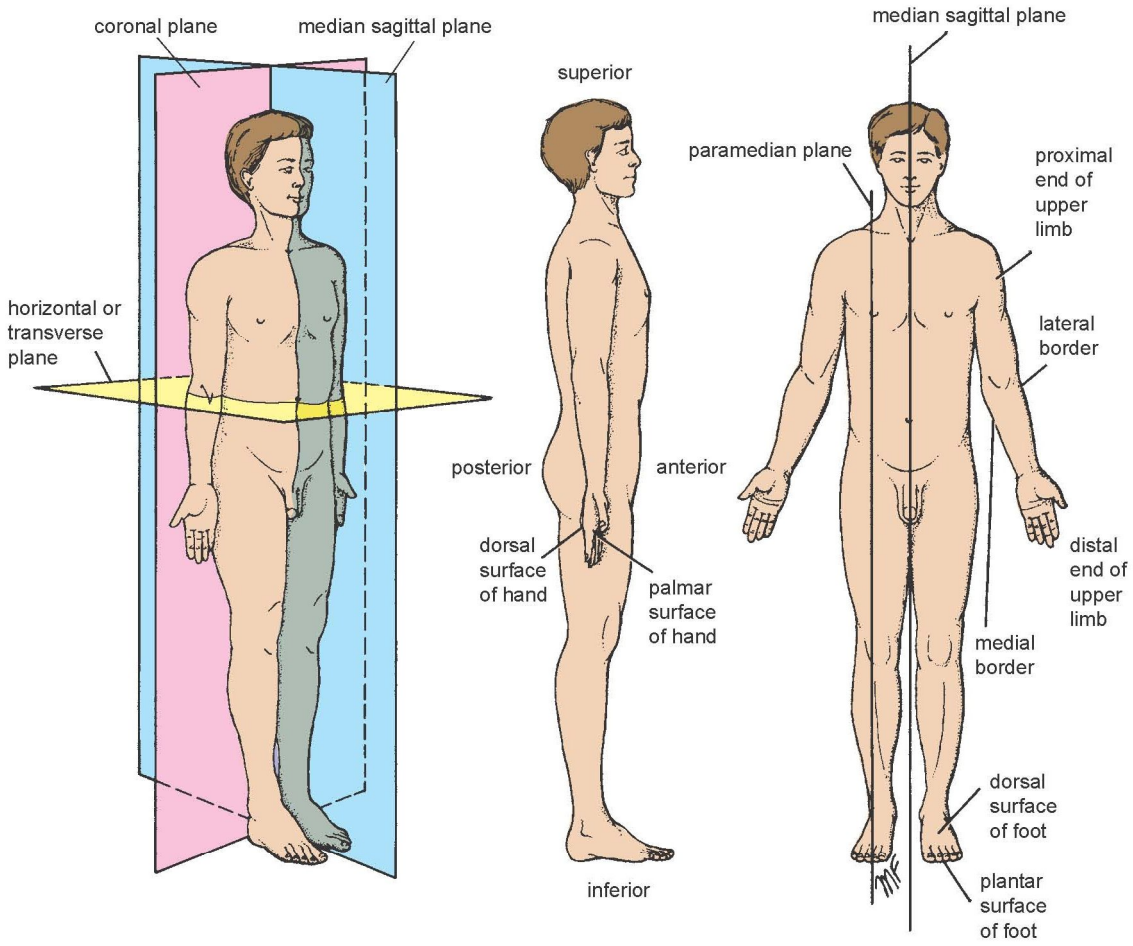

FIGURE 1.1 Anatomic terms used in relation to position. Note that the subjects are standing in the anatomic position.

Coronal Planes

These planes are imaginary vertical planes at right angles to the median plane (see Fig. 1.1).

Horizontal, or Transverse, Planes

These planes are at right angles to both the median and the coronal planes (see Fig. 1.1).

The terms **anterior** and **posterior** are used to indicate the front and back of the body, respectively (see Fig. 1.1). To describe the relationship of two structures, one is said to be anterior or posterior to the other insofar as it is closer to the anterior or posterior body surface.

In describing the hand, the terms **palmar** and **dorsal surfaces** are used in place of anterior and posterior, and in describing the foot, the terms **plantar** and **dorsal surfaces** are used instead of lower and upper surfaces (see Fig. 1.1). The terms **proximal** and **distal** describe the relative distances from the roots of the limbs; for example, the arm is proximal to the forearm and the hand is distal to the forearm.

The terms **superficial** and **deep** denote the relative distances of structures from the surface of the body, and the terms **superior** and **inferior** denote levels relatively high or low with reference to the upper and lower ends of the body.

The terms **internal** and **external** are used to describe the relative distance of a structure from the center of an organ or cavity; for example, the internal carotid artery is found inside the cranial cavity and the external carotid artery is found outside the cranial cavity.

The term **ipsilateral** refers to the same side of the body; for example, the left hand and the left foot are ipsilateral. **Contralateral** refers to opposite sides of the body; for example, the left biceps brachii muscle and the right rectus femoris muscle are contralateral.

The **supine** position of the body is lying on the back. The **prone** position is lying face downward.

Terms Related to Movement

A site where two or more bones come together is known as a **joint.** Some joints have no movement (sutures of the skull), some have only slight movement (superior tibiofibular joint), and some are freely movable (shoulder joint).

Flexion is a movement that takes place in a sagittal plane. For example, flexion of the elbow joint approximates the anterior surface of the forearm to the anterior surface of the arm. It is usually an anterior movement, but it is occasionally posterior, as in the case of the knee joint (see Fig. 1.2). **Extension** means straightening the joint and usually takes place in a posterior direction (see Fig. 1.2). **Lateral flexion** is a movement of the trunk in the coronal plane (Fig. 1.3).

Abduction is a movement of a limb away from the midline of the body in the coronal plane (see Fig. 1.2).

Adduction is a movement of a limb toward the body in the coronal plane (see Fig. 1.2). In the fingers and toes, abduction is applied to the spreading of these structures and adduction is applied to the drawing together of these structures (see Fig. 1.3). The movements of the thumb (see Fig. 1.3), which are a little more complicated, are described on page 413.

Rotation is the term applied to the movement of a part of the body around its long axis. **Medial rotation** is the movement that results in the anterior surface of the part facing medially. **Lateral rotation** is the movement that results in the anterior surface of the part facing laterally.

Pronation of the forearm is a medial rotation of the forearm in such a manner that the palm of the hand faces posteriorly (see Fig. 1.3). **Supination of the forearm** is a lateral rotation of the forearm from the pronated position so that the palm of the hand comes to face anteriorly (see Fig. 1.3).

Circumduction is the combination in sequence of the movements of flexion, extension, abduction, and adduction (see Fig. 1.2).

Protraction is to move forward; **retraction** is to move backward (used to describe the forward and backward movement of the jaw at the temporomandibular joints).

Inversion is the movement of the foot so that the sole faces in a medial direction (see Fig. 1.3). **Eversion** is the opposite movement of the foot so that the sole faces in a lateral direction (see Fig. 1.3).

Basic Structures

Skin

The skin is divided into two parts: the superficial part, the **epidermis;** and the deep part, the **dermis** (Fig. 1.4). The epidermis is a stratified epithelium whose cells become flattened as they mature and rise to the surface. On the palms of the hands and the soles of the feet, the epidermis is extremely thick, to withstand the wear and tear that occurs in these regions. In other areas of the body, for example, on the anterior surface of the arm and forearm, it is thin. The dermis is composed of dense connective tissue containing many blood vessels, lymphatic vessels, and nerves. It shows considerable variation in thickness in different parts of the body, tending to be thinner on the anterior than on the posterior surface. It is thinner in women than in men. The dermis of the skin is connected to the underlying deep fascia or bones by the **superficial fascia,** otherwise known as **subcutaneous tissue.**

The skin over joints always folds in the same place, the **SKIN CREASES** (Fig. 1.5). At these sites, the skin is thinner than elsewhere and is firmly tethered to underlying structures by strong bands of fibrous tissue.

The appendages of the skin are the nails, hair follicles, sebaceous glands, and **sweat glands.**

The **nails** are keratinized plates on the dorsal surfaces of the tips of the fingers and toes. The proximal edge of the plate is the **root of the nail** (see Fig. 1.5). With the exception of the distal edge of the plate, the nail is surrounded and overlapped by folds of skin known as **nail folds.** The surface of skin covered by the nail is the **nail bed** (see Fig. 1.5).

Hairs grow out of **follicles,** which are invaginations of the epidermis into the dermis (see Fig. 1.4). The follicles lie obliquely to the skin surface, and their expanded extremities, called **hair bulbs,** penetrate to the deeper part of the dermis. Each hair bulb is concave at its end, and the

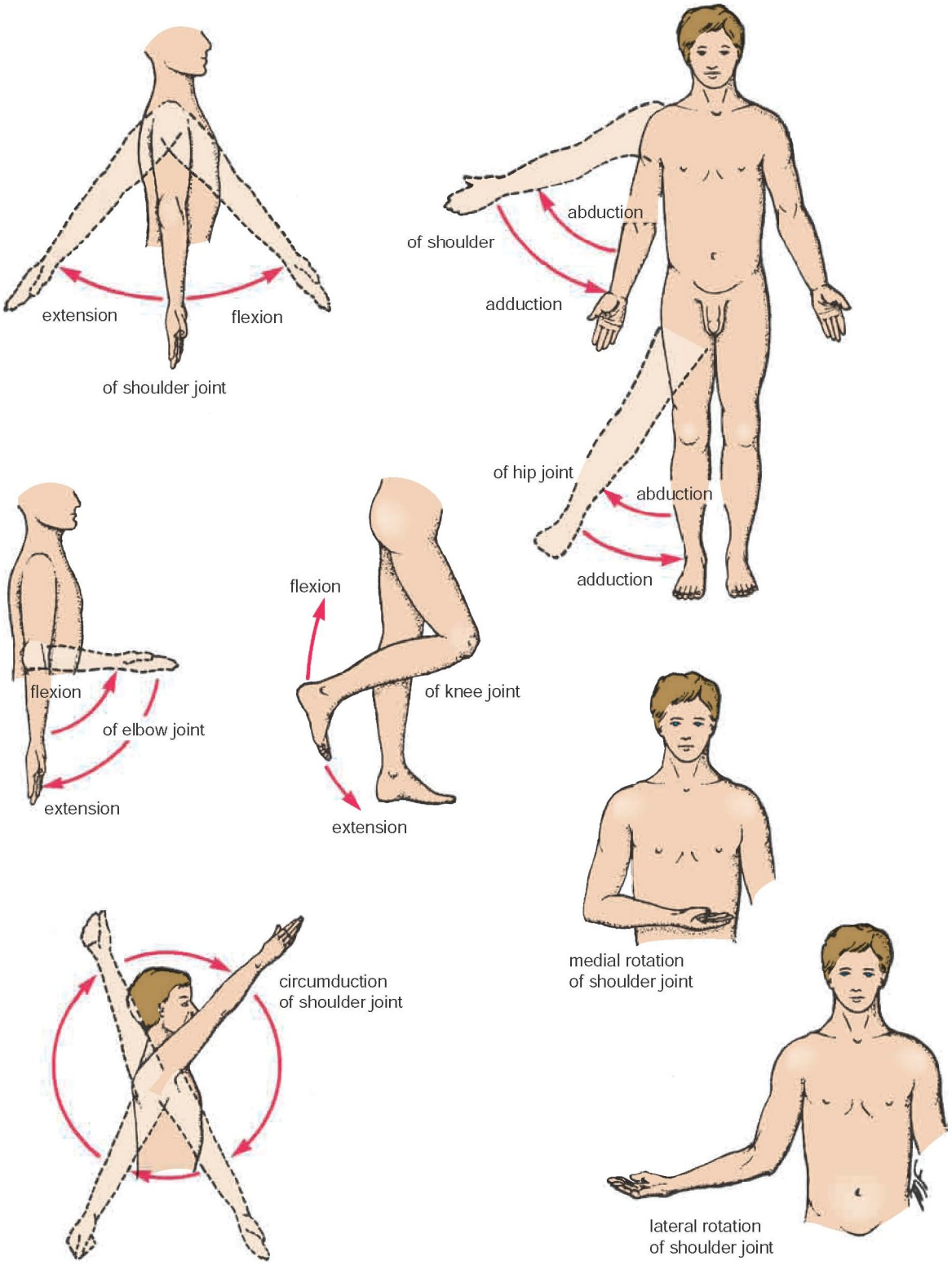

FIGURE 1.2 Some anatomic terms used in relation to movement. Note the difference between flexion of the elbow and that of the knee.

concavity is occupied by vascular connective tissue called **hair papilla.** A band of smooth muscle, the **arrector pili,** connects the undersurface of the follicle to the superficial part of the dermis (see Fig. 1.4). The muscle is innervated by sympathetic nerve fibers, and its contraction causes the hair to move into a more vertical position; it also compresses the sebaceous gland and causes it to extrude some of its secretion. The pull of the muscle also causes dimpling of the skin surface, so-called **gooseflesh.** Hairs are distributed in various numbers over the whole surface of the

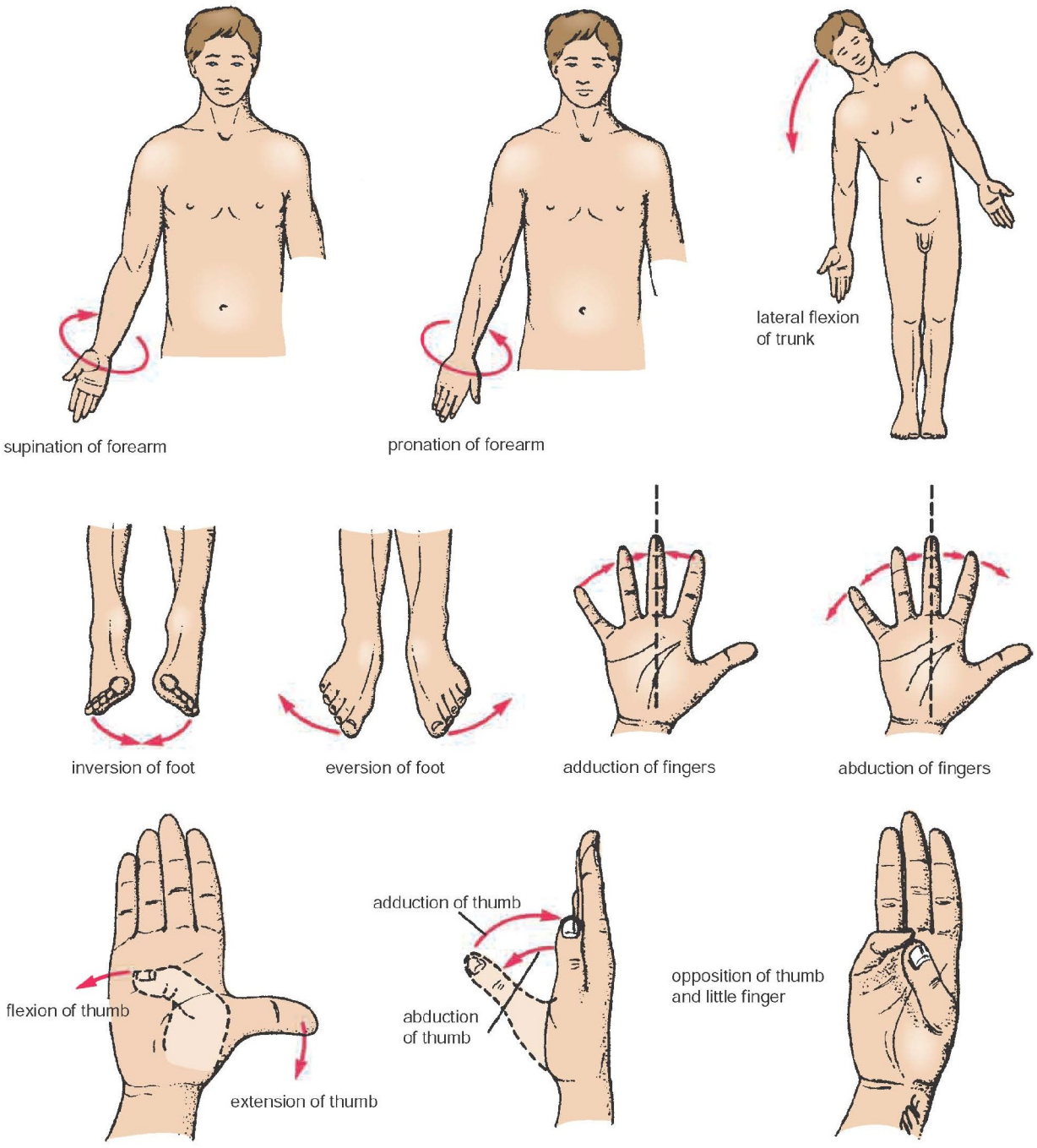

FIGURE 1.3 Additional anatomic terms used in relation to movement.

body, except on the lips, the palms of the hands, the sides of the fingers, the glans penis and clitoris, the labia minora and the internal surface of the labia majora, and the soles and sides of the feet and the sides of the toes.

Sebaceous glands pour their secretion, the sebum, onto the shafts of the hairs as they pass up through the necks of the follicles. They are situated on the sloping undersurface of the follicles and lie within the dermis (see Fig. 1.4). **Sebum** is an oily material that helps preserve the flexibility of the emerging hair. It also oils the surface epidermis around the mouth of the follicle.

Sweat glands are long, spiral, tubular glands distributed over the surface of the body, except on the red margins of the lips, the nail beds, and the glans penis and clitoris (see Fig. 1.4). These glands extend through the full thickness of the dermis, and their extremities may lie in the superficial fascia. The sweat glands are therefore the most deeply penetrating structures of all the epidermal appendages.

Basic Anatomy

The head and neck region of the body contains many important structures compressed into a relatively small area.

The Head

The head is formed mainly by the skull with the brain and its covering meninges enclosed in the cranial cavity. The special senses, the eye and the ear, lie within the skull bones or in the cavities bounded by them. The brain gives rise to 12 pairs of cranial nerves, which leave the brain and pass through foramina and fissures in the skull. All the cranial nerves are distributed to structures in the head and neck, except the 10th, which also supplies structures in the chest and abdomen.

Bones of the Skull

Composition

The skull is composed of several separate bones united at immobile joints called **sutures.** The connective tissue between the bones is called a **sutural ligament.** The mandible is an exception to this rule, for it is united to the skull by the mobile temporomandibular joint (see page 571).

The bones of the skull can be divided into those of the cranium and those of the face. The **vault** is the upper part of the cranium, and the **base of the skull** is the lowest part of the cranium (Fig. 11.1).

The skull bones are made up of **external** and **internal tables** of compact bone separated by a layer of spongy bone called the **diploë** (Fig. 11.2). The internal table is thinner and more brittle than the external table. The bones are covered on the outer and inner surfaces with periosteum.

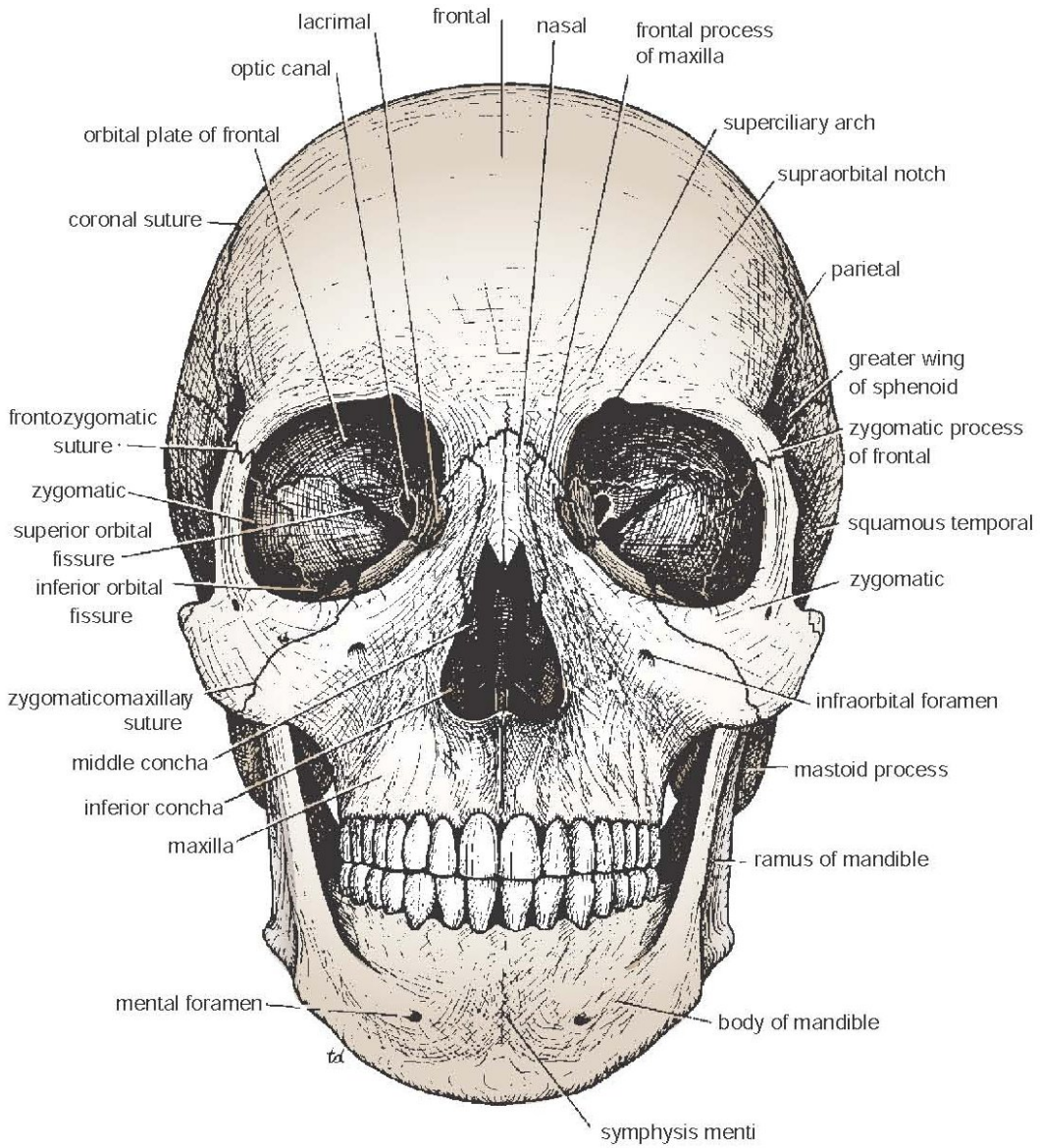

FIGURE 11.1 Bones of the anterior aspect of the skull.

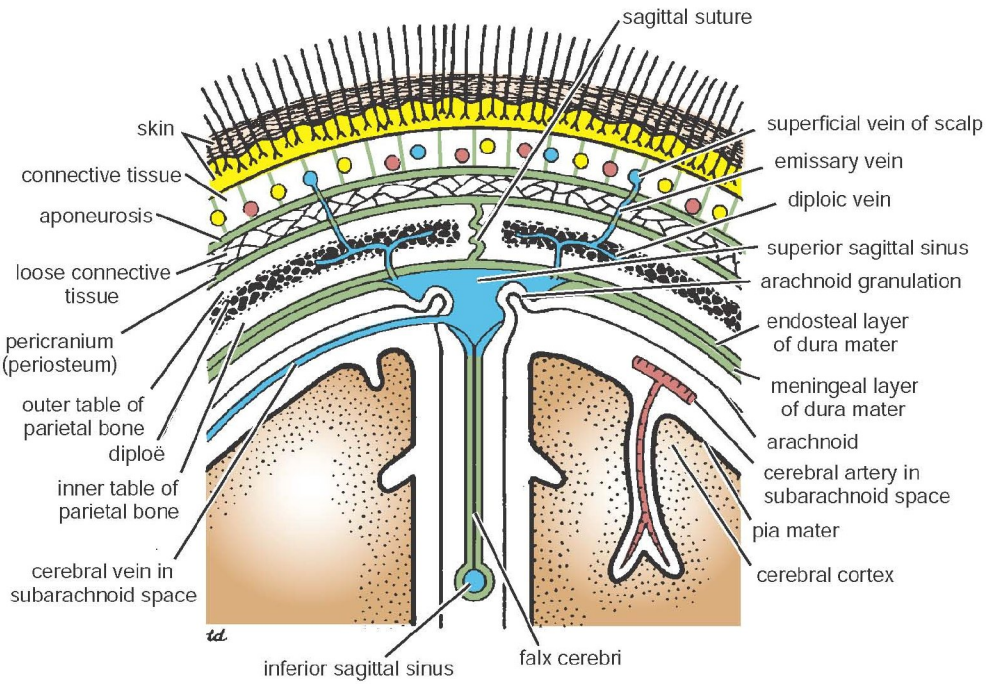

FIGURE 11.2 Coronal section of the upper part of the head showing the layers of the scalp, the sagittal suture of the skull, the falx cerebri, the superior and inferior sagittal venous sinuses, the arachnoid granulations, the emissary veins, and the relation of cerebral blood vessels to the subarachnoid space.

The **cranium** consists of the following bones, two of which are paired (Figs. 11.3 and 11.4):

- Frontal bone: 1
- Parietal bones: 2
- Occipital bone: 1
- Temporal bones: 2
- Sphenoid bone: 1
- Ethmoid bone: 1

The **facial bones** consist of the following, two of which are single:

- Zygomatic bones: 2
- Maxillae: 2
- Nasal bones: 2
- Lacrimal bones: 2
- Vomer: 1
- Palatine bones: 2
- Inferior conchae: 2
- Mandible: 1

It is unnecessary for students of medicine to know the detailed structure of each individual skull bone. However, students should be familiar with the skull as a whole and should have a dried skull available for reference as they read the following description.

External Views of the Skull

Anterior View of the Skull

The **frontal bone,** or forehead bone, curves downward to make the upper margins of the orbits (Fig. 11.1). The **superciliary arches** can be seen on either side, and the **supraorbital notch,** or **foramen,** can be recognized. Medially, the frontal bone articulates with the frontal processes of the maxillae and with the nasal bones. Laterally, the frontal bone articulates with the zygomatic bone.

The **orbital margins** are bounded by the frontal bone superiorly, the zygomatic bone laterally, the maxilla inferiorly, and the processes of the maxilla and frontal bone medially.

Within the **frontal bone,** just above the orbital margins, are two hollow spaces lined with mucous membrane called the **frontal air sinuses.** These communicate with the nose and serve as voice resonators.

The **two nasal bones** form the bridge of the nose. Their lower borders, with the maxillae, make the **anterior nasal aperture.** The nasal cavity is divided into two by the bony nasal septum, which is largely formed by the **vomer.** The **superior** and **middle conchae** are shelves of bone that project into the nasal cavity from the **ethmoid** on each side; the **inferior conchae** are separate bones.

The two **maxillae** form the upper jaw, the anterior part of the hard palate, part of the lateral walls of the nasal cavities, and part of the floors of the orbital cavities. The two bones meet in the midline at the **intermaxillary suture** and form the lower margin of the nasal aperture. Below the orbit, the maxilla is perforated by the **infraorbital foramen.** The **alveolar process** projects downward and, together with the fellow of the opposite side, forms the **alveolar arch,** which carries the upper teeth. Within each maxilla is a large, pyramid-shaped cavity lined with mucous membrane called the **maxillary sinus.** This communicates with the nasal cavity and serves as a voice resonator.

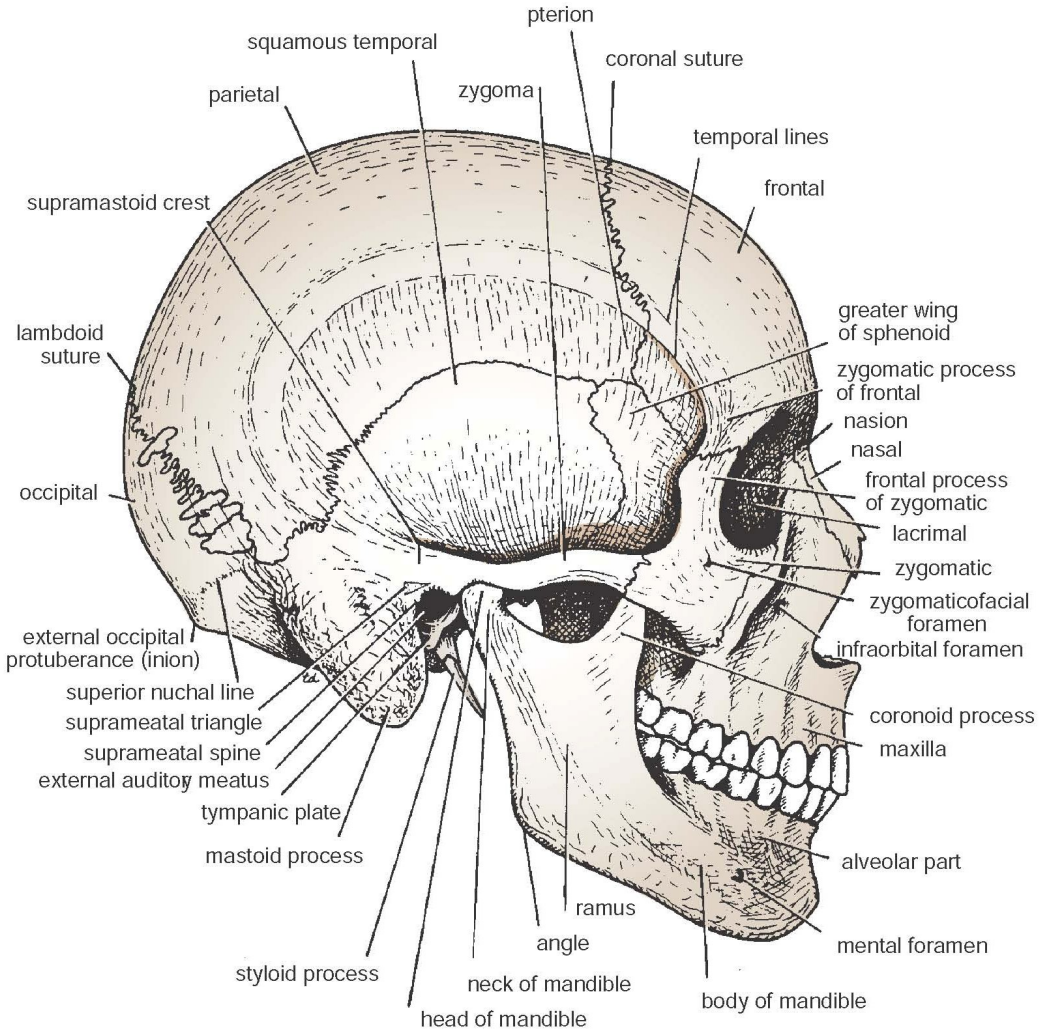

FIGURE 11.3 Bones of the lateral aspect of the skull.

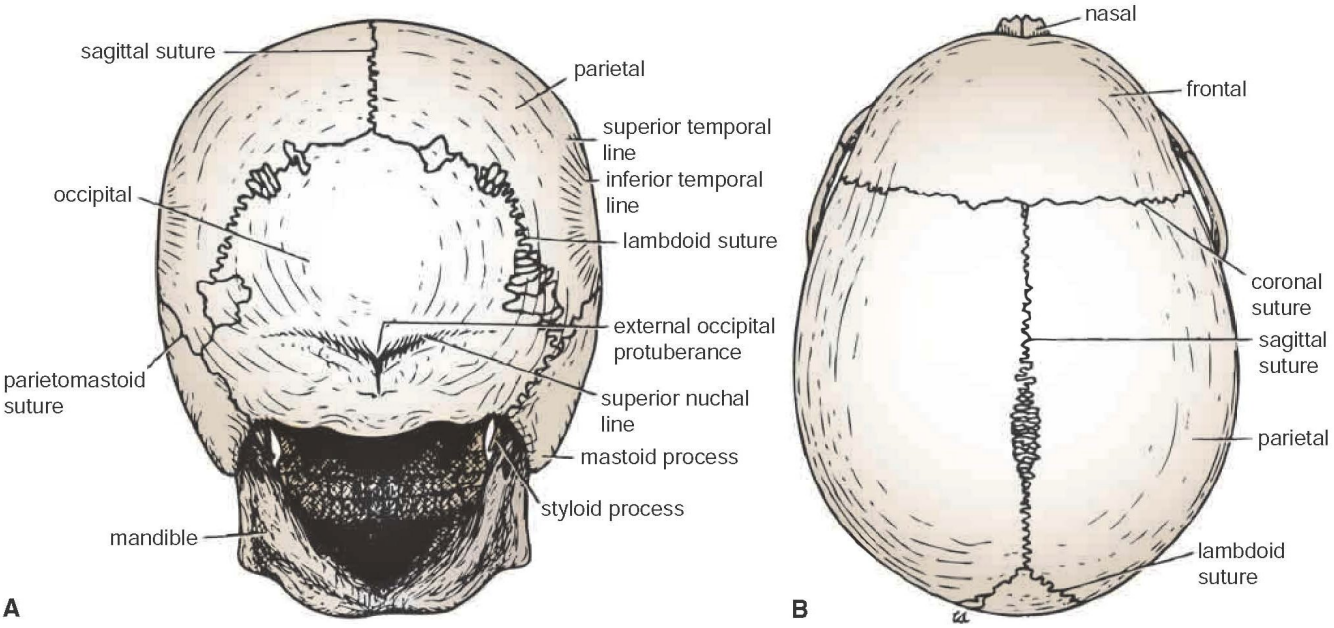

FIGURE 11.4 Bones of the skull viewed from the posterior **(A)** and superior **(B)** aspects.

The **zygomatic bone** forms the prominence of the cheek and part of the lateral wall and floor of the orbital cavity. Medially, it articulates with the maxilla and laterally it articulates with the zygomatic process of the temporal bone to form the zygomatic arch. The zygomatic bone is perforated by two foramina for the zygomaticofacial and zygomaticotemporal nerves.

The **mandible,** or lower jaw, consists of a horizontal body and two vertical rami (for details, see page 569).

Lateral View of the Skull

The **frontal bone** forms the anterior part of the side of the skull and articulates with the parietal bone at the coronal suture (Fig. 11.3).

The **parietal bones** form the sides and roof of the cranium and articulate with each other in the midline at the **sagittal suture.** They articulate with the occipital bone behind, at the **lambdoid suture.**

The skull is completed at the side by the squamous part of the **occipital bone;** parts of the **temporal bone,** namely, the **squamous, tympanic, mastoid process, styloid process,** and **zygomatic process;** and the **greater wing of the sphenoid.** Note the position of the external auditory meatus. The ramus and body of the mandible lie inferiorly.

Note that the thinnest part of the lateral wall of the skull is where the anteroinferior corner of the parietal bone articulates with the greater wing of the sphenoid; this point is referred to as the **pterion.**

Clinically, the pterion is an important area because it overlies the anterior division of the **middle meningeal artery** and **vein.**

Identify the **superior** and **inferior temporal lines,** which begin as a single line from the posterior margin of the zygomatic process of the frontal bone and diverge as they arch backward. The **temporal fossa** lies below the inferior temporal line.

The **infratemporal fossa** lies below the **infratemporal crest** on the greater wing of the sphenoid. The **pterygomaxillary fissure** is a vertical fissure that lies within the fossa between the pterygoid process of the sphenoid bone and back of the maxilla. It leads medially into the **pterygopalatine fossa.**

The **inferior orbital fissure** is a horizontal fissure between the greater wing of the sphenoid bone and the maxilla. It leads forward into the orbit.

The **pterygopalatine fossa** is a small space behind and below the orbital cavity. It communicates laterally with the infratemporal fossa through the pterygomaxillary fissure, medially with the nasal cavity through the **sphenopalatine foramen,** superiorly with the skull through the foramen rotundum, and anteriorly with the orbit through the **inferior orbital fissure.**

Posterior View of the Skull

The posterior parts of the two parietal bones (Fig. 11.4) with the intervening **sagittal suture** are seen above. Below, the parietal bones articulate with the squamous part of the occipital bone at the **lambdoid suture.** On each side the occipital bone articulates with the temporal bone. In the midline of the occipital bone is a roughened elevation called the **external occipital protuberance,** which gives attachment to muscles and the ligamentum nuchae. On either side of the protuberance the **superior nuchal lines** extend laterally toward the temporal bone.

Superior View of the Skull

Anteriorly, the frontal bone (Fig. 11.4) articulates with the two parietal bones at the **coronal suture.** Occasionally, the two halves of the frontal bone fail to fuse, leaving a midline **metopic suture.** Behind, the two parietal bones articulate in the midline at the **sagittal suture.**

Inferior View of the Skull

If the mandible is discarded, the anterior part of this aspect of the skull is seen to be formed by the **hard palate** (Fig. 11.5).

The **palatal processes of the maxillae** and the **horizontal plates of the palatine bones** can be identified. In the midline anteriorly is the **incisive fossa** and **foramen.** Posterolaterally are the **greater** and **lesser palatine foramina.**

Above the posterior edge of the hard palate are the **choanae** (posterior nasal apertures). These are separated from each other by the posterior margin of the **vomer** and are bounded laterally by the **medial pterygoid plates** of the sphenoid bone. The inferior end of the **medial pterygoid plate** is prolonged as a curved spike of bone, the **pterygoid hamulus.**

Posterolateral to the **lateral pterygoid plate,** the greater wing of the sphenoid is pierced by the large **foramen ovale** and the small **foramen spinosum.** Posterolateral to the foramen spinosum is the **spine of the sphenoid.**

Behind the spine of the sphenoid, in the interval between the greater wing of the sphenoid and the petrous part of the temporal bone, is a groove for the cartilaginous part of the **auditory tube.** The opening of the bony part of the tube can be identified.

The **mandibular fossa** of the temporal bone and the **articular tubercle** form the upper articular surfaces for the temporomandibular joint. Separating the mandibular fossa from the tympanic plate posteriorly is the **squamotympanic fissure,** through the medial end of which the chorda tympani nerve exits from the tympanic cavity.

The **styloid process** of the temporal bone projects downward and forward from its inferior aspect. The opening of the **carotid canal** can be seen on the inferior surface of the petrous part of the temporal bone.

The medial end of the petrous part of the temporal bone is irregular and, together with the basilar part of the occipital bone and the greater wing of the sphenoid, forms the **foramen lacerum.** During life, the foramen lacerum is closed with fibrous tissue, and only a few small vessels pass through this foramen from the cavity of the skull to the exterior.

The **tympanic plate,** which forms part of the temporal bone, is C shaped on section and forms the bony part of the **external auditory meatus.** While examining this region, identify the **suprameatal crest** on the lateral surface of

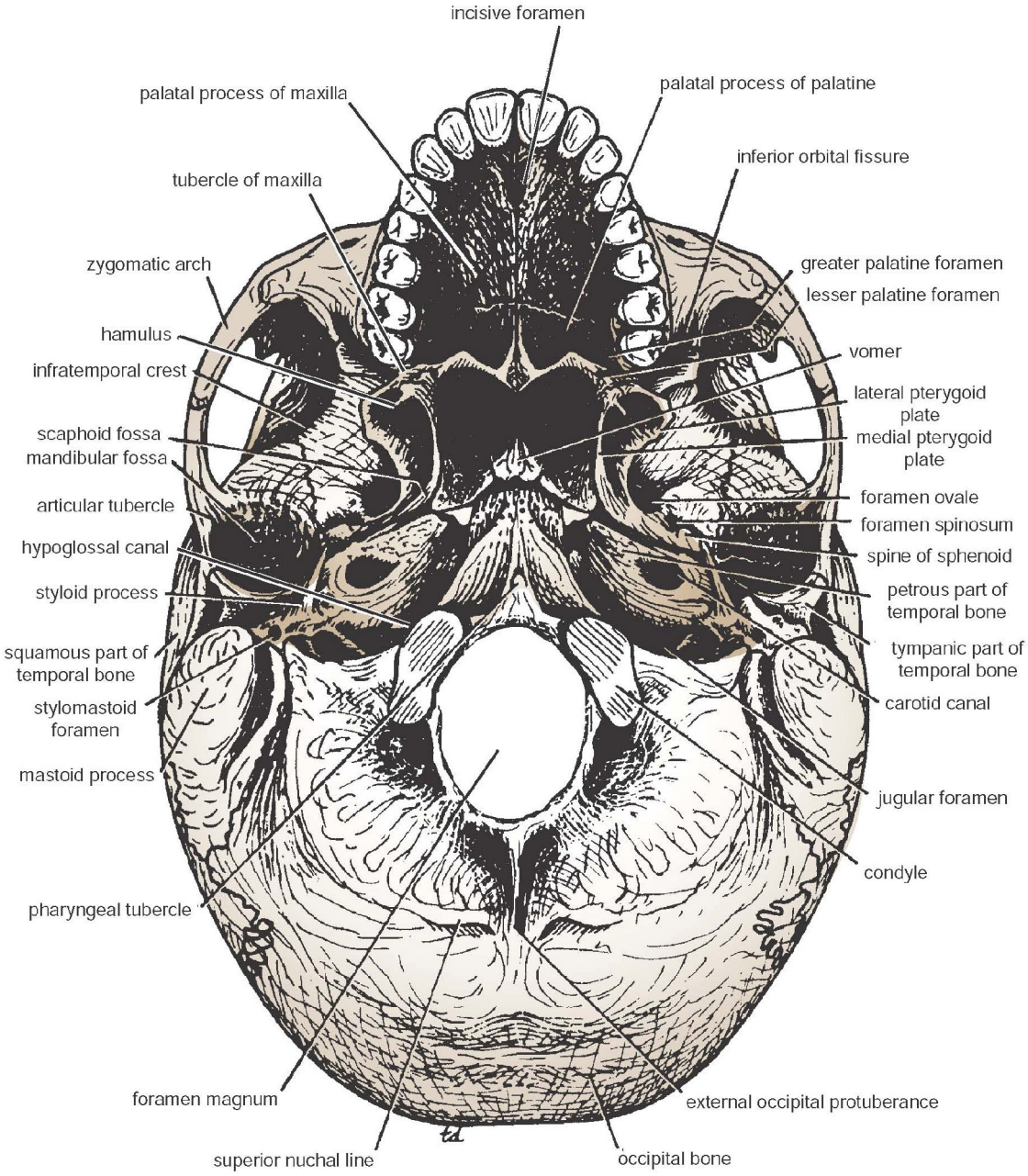

FIGURE 11.5 Inferior surface of the base of the skull.

the squamous part of the temporal bone, the **suprameatal triangle,** and the **suprameatal spine.**

In the interval between the styloid and mastoid processes, the **stylomastoid foramen** can be seen. Medial to the styloid process, the petrous part of the temporal bone has a deep notch, which, together with a shallower notch on the occipital bone, forms the **jugular foramen.**

Behind the posterior apertures of the nose and in front of the foramen magnum are the sphenoid bone and the basilar part of the occipital bone. The **pharyngeal tubercle** is a small prominence on the undersurface of the basilar part of the occipital bone in the midline.

The **occipital condyles** should be identified; they articulate with the superior aspect of the lateral mass of the first cervical vertebra, the atlas. Superior to the occipital condyle is the **hypoglossal canal** for transmission of the hypoglossal nerve (Fig. 11.6).

Posterior to the foramen magnum in the midline is the external occipital protuberance. The superior nuchal lines should be identified as they curve laterally on each side.

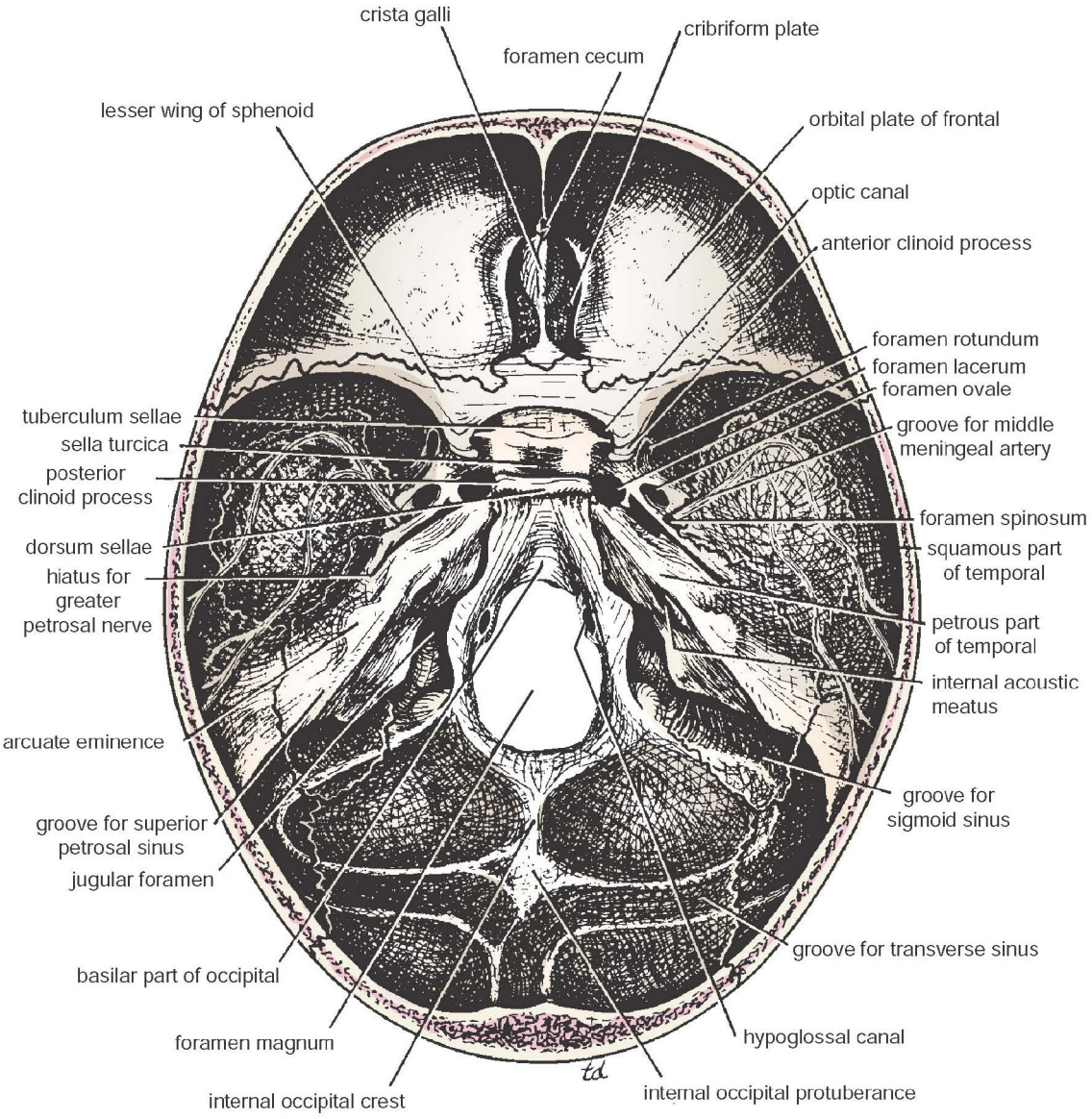

FIGURE 11.6 Internal surface of the base of the skull.

The Cranial Cavity

The cranial cavity contains the brain and its surrounding meninges, portions of the cranial nerves, arteries, veins, and venous sinuses.

Vault of the Skull

The internal surface of the vault shows the coronal, sagittal, and lambdoid sutures. In the midline is a shallow sagittal groove that lodges the **superior sagittal sinus.** On each side of the groove are several small pits, called **granular pits,** which lodge the **lateral lacunae** and **arachnoid granulations** (see page 543). Several narrow grooves are present for the anterior and posterior divisions of the **middle meningeal vessels** as they pass up the side of the skull to the vault.

Base of the Skull

The interior of the base of the skull (Fig. 11.6) is divided into three cranial fossae: anterior, middle, and posterior. The anterior cranial fossa is separated from the middle cranial fossa by the lesser wing of the sphenoid, and the middle cranial fossa is separated from the posterior cranial fossa by the petrous part of the temporal bone.

Anterior Cranial Fossa

The anterior cranial fossa lodges the frontal lobes of the cerebral hemispheres. It is bounded anteriorly by the inner surface of the frontal bone, and in the midline is a crest for the attachment of the **falx cerebri.** Its posterior boundary is the sharp lesser wing of the sphenoid, which articulates laterally with the frontal bone and meets the anteroinferior angle of the parietal bone, or the pterion. The medial end of

the lesser wing of the sphenoid forms the **anterior clinoid process** on each side, which gives attachment to the **tentorium cerebelli.** The median part of the anterior cranial fossa is limited posteriorly by the groove for the optic chiasma.

The floor of the fossa is formed by the ridged orbital plates of the frontal bone laterally and by the **cribriform plate** of the ethmoid medially (Fig. 11.6). The **crista galli** is a sharp upward projection of the ethmoid bone in the midline for the attachment of the falx cerebri. Alongside the crista galli is a narrow slit in the cribriform plate for the passage of the **anterior ethmoidal nerve** into the nasal cavity. The upper surface of the cribriform plate supports the olfactory bulbs, and the small perforations in the cribriform plate are for the **olfactory nerves.**

Middle Cranial Fossa

The middle cranial fossa consists of a small median part and expanded lateral parts (Fig. 11.6). The median raised part is formed by the body of the sphenoid, and the expanded lateral parts form concavities on either side, which lodge the **temporal lobes** of the **cerebral hemispheres.**

It is bounded anteriorly by the lesser wings of the sphenoid and posteriorly by the superior borders of the petrous parts of the temporal bones. Laterally lie the squamous parts of the temporal bones, the greater wings of the sphenoid, and the parietal bones.

The floor of each lateral part of the middle cranial fossa is formed by the greater wing of the sphenoid and the squamous and petrous parts of the temporal bone.

The sphenoid bone resembles a bat having a centrally placed **body** with **greater** and **lesser wings** that are outstretched on each side. The body of the sphenoid contains the **sphenoid air sinuses,** which are lined with mucous membrane and communicate with the nasal cavity; they serve as voice resonators.

Anteriorly, the **optic canal** transmits the optic nerve and the ophthalmic artery, a branch of the internal carotid artery, to the orbit. The **superior orbital fissure,** which is a slitlike opening between the lesser and the greater wings of the sphenoid, transmits the lacrimal, frontal, trochlear, oculomotor, nasociliary, and abducent nerves, together with the superior ophthalmic vein. The sphenoparietal venous sinus runs medially along the posterior border of the lesser wing of the sphenoid and drains into the cavernous sinus.

The **foramen rotundum,** which is situated behind the medial end of the superior orbital fissure, perforates the greater wing of the sphenoid and transmits the maxillary nerve from the trigeminal ganglion to the pterygopalatine fossa.

The **foramen ovale** lies posterolateral to the foramen rotundum (Fig. 11.6). It perforates the greater wing of the sphenoid and transmits the large sensory root and small motor root of the mandibular nerve to the infratemporal fossa; the lesser petrosal nerve also passes through it.

The small **foramen spinosum** lies posterolateral to the foramen ovale and also perforates the greater wing of the sphenoid. The foramen transmits the middle meningeal artery from the infratemporal fossa (see page 598) into the cranial cavity. The artery then runs forward and laterally in a groove on the upper surface of the squamous part of the temporal bone and the greater wing of the sphenoid (Fig. 11.20). After a short distance, the artery divides into anterior and posterior branches. The anterior branch passes forward and upward to the anteroinferior angle of the parietal bone (Fig. 11.131A). Here, the bone is deeply grooved or tunneled by the artery for a short distance before it runs backward and upward on the parietal bone. It is at this site that the artery may be damaged after a blow to the side of the head. The posterior branch passes backward and upward across the squamous part of the temporal bone to reach the parietal bone.

The large and irregularly shaped **foramen lacerum** lies between the apex of the petrous part of the temporal bone and the sphenoid bone (Fig. 11.6). The inferior opening of the foramen lacerum in life is filled by cartilage and fibrous tissue, and only small blood vessels pass through this tissue from the cranial cavity to the neck.

The **carotid canal** opens into the side of the foramen lacerum above the closed inferior opening. The internal carotid artery enters the foramen through the carotid canal and immediately turns upward to reach the side of the body of the sphenoid bone. Here, the artery turns forward in the cavernous sinus to reach the region of the anterior clinoid process. At this point, the internal carotid artery turns vertically upward, medial (Fig. 11.20) to the anterior clinoid process, and emerges from the cavernous sinus (see page 598).

Lateral to the foramen lacerum is an impression on the apex of the petrous part of the temporal bone for the **trigeminal ganglion.** On the anterior surface of the petrous bone are two grooves for nerves; the largest medial groove is for the **greater petrosal nerve,** a branch of the facial nerve; the smaller lateral groove is for the **lesser petrosal nerve,** a branch of the tympanic plexus. The greater petrosal nerve enters the foramen lacerum deep to the trigeminal ganglion and joins the **deep petrosal nerve** (sympathetic fibers from around the internal carotid artery), to form the **nerve of the pterygoid canal.** The lesser petrosal nerve passes forward to the foramen ovale.

The abducent nerve bends sharply forward across the apex of the petrous bone, medial to the trigeminal ganglion. Here, it leaves the posterior cranial fossa and enters the cavernous sinus.

The **arcuate eminence** is a rounded eminence found on the anterior surface of the petrous bone and is caused by the underlying **superior semicircular canal.**

The **tegmen tympani,** a thin plate of bone, is a forward extension of the petrous part of the temporal bone and adjoins the squamous part of the bone (Fig. 11.6). From behind forward, it forms the roof of the mastoid antrum, the tympanic cavity, and the auditory tube. This thin plate of bone is the only major barrier that separates infection in the tympanic cavity from the temporal lobe of the cerebral hemisphere (Fig. 11.30).

The median part of the middle cranial fossa is formed by the body of the sphenoid bone (Fig. 11.6). In front is the **sulcus chiasmatis,** which is related to the optic chiasma and leads laterally to the **optic canal** on each side. Posterior to the sulcus is an elevation, the **tuberculum sellae.** Behind the elevation is a deep depression, the **sella turcica,** which lodges the **pituitary gland.** The sella turcica is bounded posteriorly by a square plate of bone called the **dorsum sellae.** The superior angles of the dorsum sellae have two tubercles, called the **posterior clinoid processes,** which give attachment to the fixed margin of the tentorium cerebelli.

The cavernous sinus is directly related to the side of the body of the sphenoid (Figs. 11.9 and 11.10). It carries in its

lateral wall the 3rd and 4th cranial nerves and the ophthalmic and maxillary divisions of the 5th cranial nerve (Fig. 11.12). The internal carotid artery and the 6th cranial nerve pass forward through the sinus.

Posterior Cranial Fossa

The posterior cranial fossa is deep and lodges the parts of the hindbrain, namely, the **cerebellum, pons,** and **medulla oblongata.** Anteriorly, the fossa is bounded by the superior border of the petrous part of the temporal bone, and posteriorly it is bounded by the internal surface of the squamous part of the occipital bone (Fig. 11.6). The floor of the posterior fossa is formed by the basilar, condylar, and squamous parts of the occipital bone and the mastoid part of the temporal bone.

The roof of the fossa is formed by a fold of dura, the **tentorium cerebelli,** which intervenes between the cerebellum below and the occipital lobes of the cerebral hemispheres above (Fig. 11.10).

The **foramen magnum** occupies the central area of the floor and transmits the medulla oblongata and its surrounding meninges, the ascending spinal parts of the accessory nerves, and the two vertebral arteries.

The **hypoglossal canal** is situated above the anterolateral boundary of the foramen magnum (Fig. 11.6) and transmits the **hypoglossal nerve.**

The **jugular foramen** lies between the lower border of the petrous part of the temporal bone and the condylar part of the occipital bone. It transmits the following structures from before backward: the **inferior petrosal sinus;** the **9th, 10th,** and **11th cranial nerves;** and the large **sigmoid sinus.** The inferior petrosal sinus descends in the groove on the lower border of the petrous part of the temporal bone to reach the foramen. The sigmoid sinus turns down through the foramen to become the **internal jugular vein.**

The **internal acoustic meatus** pierces the posterior surface of the petrous part of the temporal bone. It transmits the vestibulocochlear nerve and the motor and sensory roots of the facial nerve.

The **internal occipital crest** runs upward in the midline posteriorly from the foramen magnum to the **internal occipital protuberance;** to it is attached the small **falx cerebelli** over the **occipital sinus.**

On each side of the internal occipital protuberance is a wide groove for the **transverse sinus** (Fig. 11.6). This groove sweeps around on either side, on the internal surface of the occipital bone, to reach the posteroinferior angle or corner of the parietal bone. The groove now passes onto the mastoid part of the temporal bone, and here the transverse sinus becomes the **sigmoid sinus.** The **superior petrosal sinus** runs backward along the upper border of the petrous bone in a narrow groove and drains into the sigmoid sinus. As the sigmoid sinus descends to the jugular foramen, it deeply grooves the back of the petrous bone and the mastoid part of the temporal bone. Here, it lies directly posterior to the mastoid antrum.

Table 11.1 provides a summary of the more important openings in the base of the skull and the structures that pass through them.

TABLE 11.1 Summary of the More Important Openings in the Base of the Skull and the Structures That Pass Through Them

Opening in Skull	Bone of Skull	Structures Transmitted
Anterior Cranial Fossa		
Perforations in cribriform plate	Ethmoid	Olfactory nerves
Middle Cranial Fossa		
Optic canal	Lesser wing of sphenoid	Optic nerve, ophthalmic artery
Superior orbital fissure	Between lesser and greater wings of sphenoid	Lacrimal, frontal, trochlear, oculomotor, nasociliary, and abducent nerves; superior ophthalmic vein
Foramen rotundum	Greater wing of sphenoid	Maxillary division of the trigeminal nerve
Foramen ovale	Greater wing of sphenoid	Mandibular division of the trigeminal nerve, lesser petrosal nerve
Foramen spinosum	Greater wing of sphenoid	Middle meningeal artery
Foramen lacerum	Between petrous part of temporal and sphenoid	Internal carotid artery
Posterior Cranial Fossa		
Foramen magnum	Occipital	Medulla oblongata, spinal part of accessory nerve, and right and left vertebral arteries
Hypoglossal canal	Occipital	Hypoglossal nerve
Jugular foramen	Between petrous part of temporal and condylar part of occipital	Glossopharyngeal, vagus, and accessory nerves; sigmoid sinus becomes internal jugular vein
Internal acoustic m	Petrous part of temporal	Vestibulocochlear and facial nerves